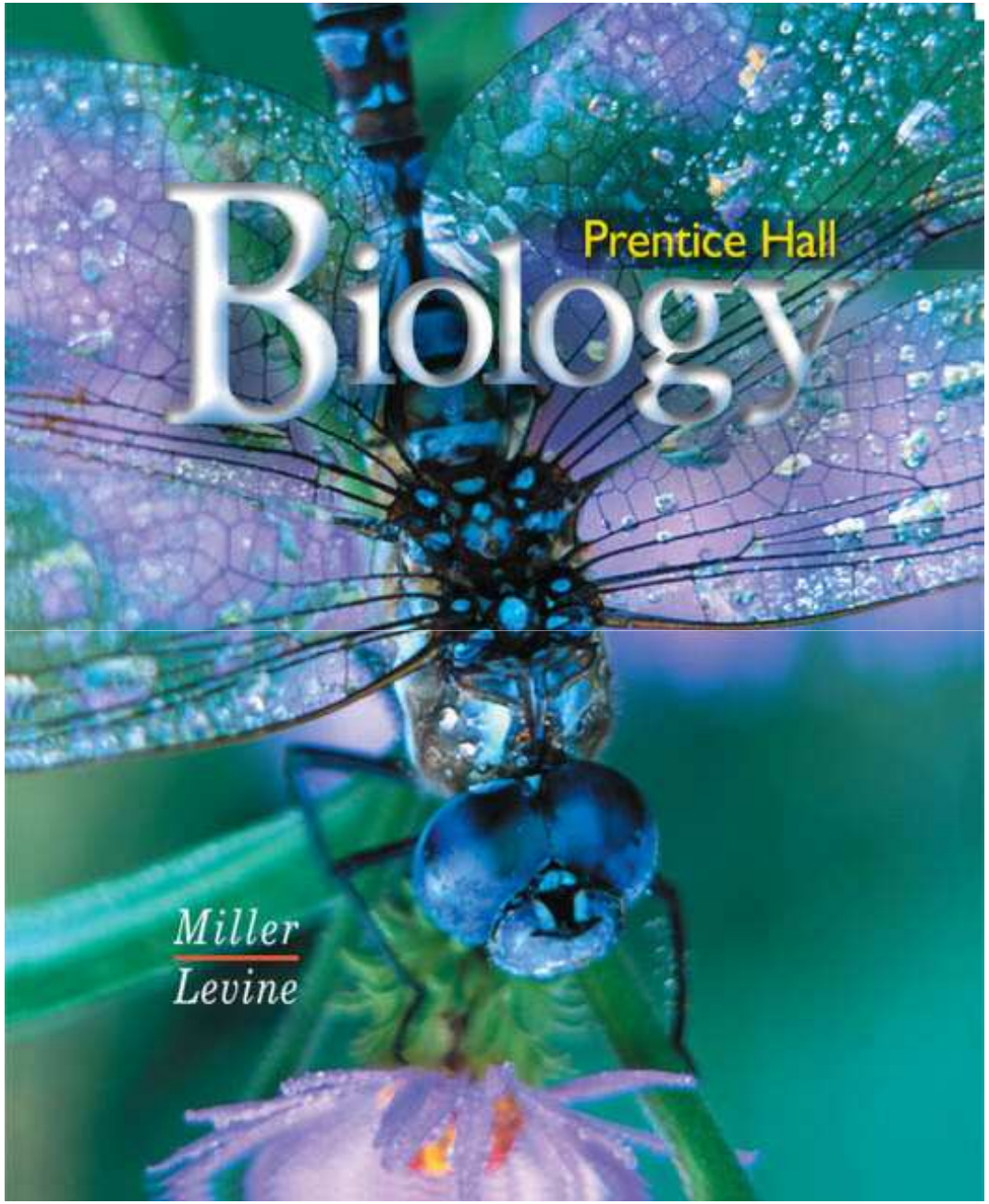


8-2 Photosynthesis: An Overview

8-2 Photosynthesis: An Overview

The key cellular process identified with energy production is **photosynthesis**.

Photosynthesis is the process in which green plants use the energy of sunlight to convert water and carbon dioxide into high-energy carbohydrates and oxygen.

What did the experiments of van Helmont, Priestley, and Ingenhousz reveal about how plants grow?

Draw the timeline (p. 204) and list the contributions of the 3 scientists.

Investigating Photosynthesis

Research into photosynthesis began centuries ago.

Van Helmont's Experiment

In the 1600s, Jan van Helmont wanted to find out if plants grew by taking material out of the soil.

He determined the mass of a pot of dry soil and a small seedling, planted the seedling in the pot, and watered it regularly.

After five years, the seedling was a small tree and had gained 75 kg, but the soil's mass was almost unchanged.

Van Helmont concluded that the gain in mass came from water because water was the only thing he had added.

His experiment accounts for the “hydrate,” or water, portion of the carbohydrate produced by photosynthesis.

But where does the carbon of the “carbo-” portion come from?

Although van Helmont did not realize it, carbon dioxide in the air made a major contribution to the mass of his tree.

In photosynthesis, the carbon in carbon dioxide is used to make sugars and other carbohydrates.

Van Helmont had only part of the story, but he had made a major contribution to science.

Priestley's Experiment

More than 100 years after van Helmont's experiment, Joseph Priestley provided another insight into the process of photosynthesis.

Priestley took a candle, placed a glass jar over it, and watched as the flame gradually died out.

He reasoned that the flame needed something in the air to keep burning and when it was used up, the flame went out. That substance was oxygen.

Priestley then placed a live sprig of mint under the jar and allowed a few days to pass.

He found that the candle could be relighted and would remain lighted for a while.

The mint plant had produced the substance required for burning. In other words, it had released oxygen.

Jan Ingenhousz

Later, Jan Ingenhousz showed that the effect observed by Priestley occurred only when the plant was exposed to light.

The results of both Priestley's and Ingenhousz's experiments showed that light is necessary for plants to produce oxygen.

The experiments performed by van Helmont, Priestley, and Ingenhousz led to work by other scientists who finally discovered that, in the presence of light, plants transform carbon dioxide and water into carbohydrates, and they also release oxygen.

What is the overall equation for photosynthesis?

The Photosynthesis Equation

The equation for photosynthesis is:

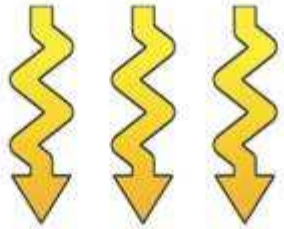
$$6CO_2 + 6H_2O \xrightarrow{\text{Light}} C_6H_{12}O_6 + 6O_2$$

$$\text{carbon dioxide} + \text{water} \xrightarrow{\text{Light}} \text{sugars} + \text{oxygen}$$

Photosynthesis uses the energy of sunlight to convert water and carbon dioxide into high-energy sugars and oxygen.

active art
click to start

Light energy



Light-Dependent Reactions (thylakoids)

H_2O

ATP
NADPH

Calvin Cycle (stroma)

What is the role of light and chlorophyll in photosynthesis?

Light and Pigments

How do plants capture the energy of sunlight?

In addition to water and carbon dioxide, photosynthesis requires light and chlorophyll.

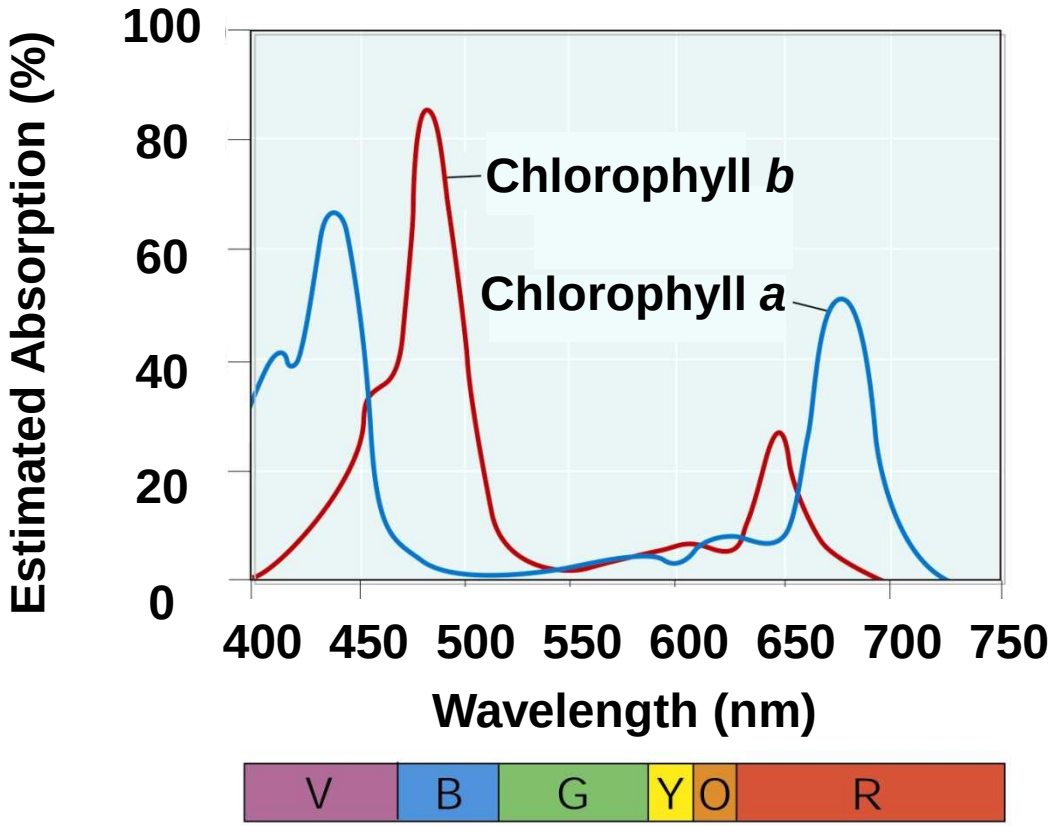
Plants gather the sun's energy with light-absorbing molecules called **pigments**.

The main pigment in plants is **chlorophyll.**

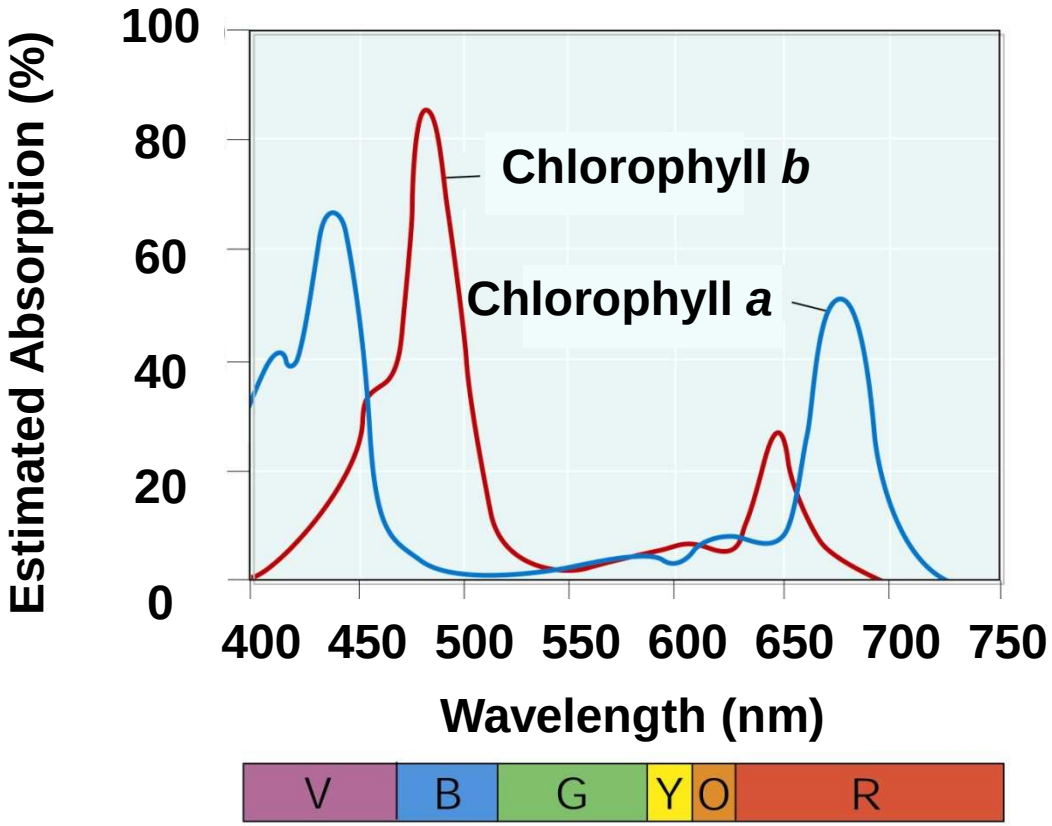
There are two main types of chlorophyll:

- chlorophyll *a*
- chlorophyll *b*

Chlorophyll absorbs light well in the blue-violet and red regions of the visible spectrum.



Chlorophyll does not absorb light well in the green region of the spectrum. Green light is reflected by leaves, which is why plants look green.



Light is a form of energy, so any compound that absorbs light also absorbs energy from that light.

When chlorophyll absorbs light, much of the energy is transferred directly to electrons in the chlorophyll molecule, raising the energy levels of these electrons.

These high-energy electrons are what make photosynthesis work.

8-2 Section QUIZ

Continue to:

Section QUIZ

- or -

Click to Launch:

8-2 Section QUIZ

1 In van Helmont's experiment, most of the added mass of the tree came from

a. soil and carbon dioxide.

A b. water and carbon dioxide.

c. oxygen and carbon dioxide.

d. soil and oxygen.

8-2 Section QUIZ

2 Plants use the sugars produced in photosynthesis to make

a. oxygen.

A b. starches.

c. carbon dioxide.

d. protein.

8-2 Section QUIZ

3 The raw materials required for plants to carry out photosynthesis are

a. carbon dioxide and oxygen.

b. oxygen and sugars.

A c. carbon dioxide and water.

d. oxygen and water.

8-2 Section QUIZ

4 The principal pigment in plants is

a. chloroplast.

A b. chlorophyll.

c. carotene.

d. carbohydrate.

8-2 Section QUIZ

5 The colors of light that are absorbed by chlorophylls are

a. green and yellow.

b. green, blue, and violet.

A c. blue, violet, and red.

d. red and yellow.

END OF SECTION